Section 2

Photosynthesis and Light

Objectives

After this lesson, students will be able to

A.4.2.1 Explain what happens when light strikes a green leaf.

A.4.2.2 Describe the overall process of photosynthesis.

Target Reading Skill

Previewing Visuals Explain that looking at visuals before they read helps students activate prior knowledge and predict what they are about to read.

Answers

Possible questions and answers include: **How is sunlight involved in photosynthesis?** *(The energy in sunlight is used to make sugar.)* **Why does a plant need sugar?** *(The plant uses energy from the sugar to carry out life functions.)* **How does the plant use the water its roots take in?** *(Water molecules combine with carbon dioxide to form sugar and oxygen during photosynthesis.)*

All in One **Teaching Resources**

- Transparency A29

Preteach

Build Background Knowledge

L1

Colored Light, Colored Object

Ask students to describe how colored light affects the appearance of colored objects. Encourage students to think about neon lights holiday lights, and even the difference between artificial lighting at night and natural daylight. *(Students should recognize that colors appear different under different lights.)*

Section 2

Photosynthesis and Light

Reading Preview

Key Concepts

- What happens when light strikes a green leaf?
- How do scientists summarize the process of photosynthesis?

Key Terms

- transmission
- reflection
- absorption
- accessory pigment

Target Reading Skill

Previewing Visuals Preview Figure 9. Then write two questions that you have about the diagram in a graphic organizer like the one below. As you read, answer your questions.

The Photosynthesis Process

Q. How is sunlight involved in photosynthesis?
A.
Q.

Lab zone Discover Activity

What Colors Make Up Sunlight?

1. Glue a piece of white paper onto the inside bottom of a shoe box.
2. Place the box on its side near a window or outside in a sunny area.
3. Hold a mirror in front of the open side of the box. Adjust the mirror until it reflects sunlight onto the paper in the box. **CAUTION:** *Do not direct the sunlight into your eyes.*
4. Place a prism between the mirror and the box. Adjust the location of the prism so that sunlight passes through the prism.
5. Describe what you see on the paper in the box.

Think It Over

Observing What did you learn about light from this activity?

The year was 1883. T. W. Engelmann, a German biologist, was at work in his laboratory. He peered into the microscope at some algae on a slide. The microscope had a prism located between the light source and the algae. As Engelmann watched the algae, he saw gas bubbles forming in the water around some of the cells. Curiously, no gas bubbles formed around other cells. Although Engelmann did not know it at the time, his experiment provided a clue about how light is involved in photosynthesis. To understand what Engelmann observed, you need to know more about the nature of light.

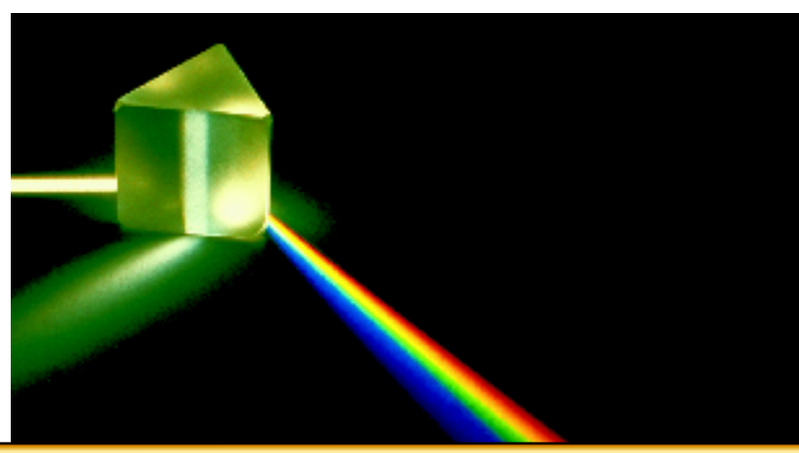


FIGURE 7
The Visible Spectrum
When white light passes through a prism, you can see that it is made up of the colors of the rainbow.

Lab zone Discover Activity

Skills Focus Observing L1

Time 10 minutes

Materials glue, hand mirror, prism, shoe box, white paper

Tips If a sunny window or bright outside area is not available, students can use bright, narrow-beam flashlights to complete the activity. You may wish to demonstrate how to hold the prism so that it projects a rainbow.

Expected Outcome When students reflect sunlight into the shoe box with a mirror, they should see white light on the paper in the shape of the mirror. When the light passes through the prism, they should see a spectrum (rainbow-like band of colors) on the paper.

Think It Over White light is made up of different colors.

Extend Challenge students to use different colors of paper inside the shoe box and describe what they see.

FIGURE 8
When Light Strikes Objects
When white light strikes the lemon and the leaf, different colors of light are reflected by the two objects. Because of the reflected light, we see the lemon as yellow and the leaf as green.
Inferring *What happens to the colors of light that are not reflected off the lemon and the leaf?*

The Nature of Light

The sun is the source of energy on Earth. If you take a walk outside on a sunny day, you feel the sun's energy as it warms your skin. You see the energy in the form of light on objects around you. The light that you see is called white light. But when white light passes through a prism like the one in Figure 7, you can see that it is made up of the colors of the rainbow. Scientists refer to these colors—red, orange, yellow, green, blue, and violet—as the visible spectrum.

When Light Strikes Objects In addition to prisms, white light strikes many other objects. Some objects such as glass and other transparent materials allow light to pass through them. This process is called **transmission.** When light hits a shiny surface such as a mirror, the light bounces back. This process is called **reflection.** When dark objects, such as street pavements, take in light, it is called **absorption.**

Most objects, however, reflect some colors of the visible spectrum while they absorb other colors. When white light strikes the lemon in Figure 8, the lemon absorbs most of the light's colors. However, the lemon reflects yellow light. The lemon looks yellow because your eyes see the reflected color.

Plants and Light Like yellow lemons and most other objects, plants absorb some colors of the visible spectrum and reflect others. **When light strikes the green leaves of a plant, most of the green part of the spectrum is reflected. Most of the other colors of light are absorbed.**

Differentiated Instruction

Gifted and Talented L3
Light and Photosynthesis Have students who need the challenge design an experiment that answers the following question: How will a plant react if it does not receive sunlight? Tell students that they could use the following materials in their activity: 2 small potted plants, a cardboard box, and a light source. Students should write their activity procedure and get approval before beginning. Allow the activity to continue for at least one week. Then have students report their findings. **learning modality: logical/mathematical**

Instruct

The Nature of Light

Teach Key Concepts L2

Reflected Colors

Focus Ask: **What colors are in white light?** *(Red, orange, yellow, green, blue, violet)*

Teach Have students compare the colors that are reflected in Figure 8. Ask: **What happens to the green in the sunlight when it reaches a plant's leaves?** *(It is reflected.)* **How does that affect what we see?** *(We see the leaf as green.)* **What happens to red and yellow in sunlight when they reach a plant leaf? How do you know?** *(They are absorbed; we do not see yellow or red, so they must be absorbed.)* **learning modality: visual**

All in One Teaching Resources
- Transparency A30

Lab zone Build Inquiry L2

Bouncing light

Materials flashlight, 2 hand mirrors
Time 15 minutes

Focus Remind students that light travels in a straight line.

Teach Dim classroom lights and allow groups of four students to work together to arrange mirrors and flashlight so that the light beam goes around a corner. Ask: **What do you observe about the path of the light?** *(It bounces off the mirrors.)*

Apply Have two pairs challenge each other. Tell them to hold the flashlight in place so that the beam shines in a straight line. Have one pair choose a point that is not on that line and challenge the other pair to direct the light to that point. Then have pairs switch roles. **learning modality: kinesthetic**

All in One Teaching Resources
- Guided Reading and Study Worksheet: *Photosynthesis and Light*

Student Edition on Audio CD

Monitor Progress L2

Answer
Figure 8 They are absorbed.

Science and History

Focus Have students study the timeline. Ask: **What does the timeline show?** *(Key dates when scientists put the pieces of the photosynthesis puzzle together)*

Teach As students read each segment of the timeline, challenge them to state the experimental question that the scientist was investigating. *(Van Helmont—What must be added to a tree for it to grow? Priestley—What happens to a burning candle sealed in a jar, with a plant and without a plant? Ingenhousz—Do leaves need sunlight to produce oxygen? Sachs—Do plants produce carbohydrates? Englemann—What colors of light are needed for photosynthesis? Calvin—What happens to the carbon in carbon dioxide during photosynthesis?)* After students have analyzed the timeline, ask: **Based on the findings of Van Helmont and Ingenhousz, what do plants need for photosynthesis?** *(Water and sunlight)* **Based on the findings of Priestley, Ingenhousz, and Sachs, what are the products of photosynthesis?** *(Oxygen and carbohydrates)*

Writing in Science

Writing Mode Dialogue

Scoring Rubric

4 Information is accurate and gives details about the scientist's contribution; dialogue is interesting and lively

3 Includes all criteria; writing is uninteresting

2 Includes most criteria

1 Includes inaccurate or incomplete information

Portfolio

Plant Pigments When light strikes a leaf, it is absorbed by pigments found in the leaf's cells. Chlorophyll, the most abundant pigment in leaves, absorbs most of the blue and red light. Most of the green light, on the other hand, is reflected rather than absorbed. This explains why chlorophyll appears green in color, and why leaves usually appear green.

Other pigments, called **accessory pigments,** are also found in leaves. These pigments, which include orange and yellow pigments, absorb different colors of light than chlorophyll does. Most accessory pigments are not visible in plants because they are masked by chlorophyll.

Reading Checkpoint **What is the most abundant pigment in leaves?**

Science and History

Unraveling the Mysteries of Photosynthesis

What do plants need to make their own food? What substances do plants produce in the process of photosynthesis? Over time, the work of many scientists has provided answers to these questions.

1643
Jean-Baptiste Van Helmont
A Dutch scientist, Jean-Baptiste Van Helmont, planted a willow tree in a tub of soil. After five years of adding only water, the tree gained 74 kilograms. Van Helmont concluded that trees need only water to grow. Today, we know that water is one of the raw materials of photosynthesis.

1771
Joseph Priestley
When Joseph Priestley, an English scientist, placed a burning candle in a covered jar, the flame went out. When he placed both a plant and a candle in a covered jar, the candle kept burning. Priestley concluded that the plant released something into the air that kept the candle burning. Today, we know that plants produce oxygen, a product of photosynthesis.

1779
Jan Ingenhousz
Jan Ingenhousz, a Dutch scientist, placed branches with leaves in water. In sunlight, the leaves produced oxygen bubbles. In the dark, the leaves produced no oxygen. Ingenhousz concluded that plants need sunlight to produce oxygen, a product of photosynthesis.

1650 1700 1750

The Photosynthesis Process

When light strikes a plant's leaves, it sets in motion the process known as photosynthesis. You can think of photosynthesis as a two-part process. First, the plant captures energy from the sun. Then, it uses that energy to produce food.

Capturing Energy Because light is one form of energy, a substance that absorbs light absorbs energy. Just as a car requires the energy in gasoline to move, plants require energy in the form of light to power photosynthesis. Photosynthesis begins when light strikes the chlorophyll in a plant's chloroplasts. The light energy that is absorbed powers the next stage of the photosynthesis process.

1883
T. W. Engelmann
Building on the work of Jan Ingenhousz, T. W. Engelmann studied how different colors of light affect photosynthesis in green algae. He found that cells bathed in blue and red light had the fastest rates of photosynthesis. Today, scientists know that the chlorophyll in green algae and plants absorbs mostly blue and red light.

1864
Julius Sachs
A German biologist, Julius Sachs, observed living leaf cells under a microscope. As he watched, he tested the cells for the presence of carbohydrates. Sachs discovered that plants produce carbohydrates during photosynthesis.

1948
Melvin Calvin
The American scientist Melvin Calvin traced the chemical path that the carbon from carbon dioxide follows during photosynthesis. By doing this, Calvin learned about the complex chemical reactions of photosynthesis.

1850 1900 1950

Writing in Science

Research and Write Find out more about one of the scientists discussed in this timeline. Write a dialogue you might have had with the scientist. Discuss how the scientist's work contributed to our current understanding of photosynthesis.

The Photosynthesis Process

Teach Key Concepts L2

The Role of Light

Focus Remind students that sunlight is a form of energy.

Teach Ask: **What are the two stages in photosynthesis?** *(First, the plant captures energy from the sun; then the plant uses the energy to power a series of chemical reactions that produce sugar and oxygen.)* **What raw materials are needed for photosynthesis?** *(Water and carbon dioxide)*

Apply Ask: **What happens to the food produced in plants that is not used?** *(It is stored.)* **How do organisms that eat plants benefit from photosynthesis?** *(When they eat plants, the organisms get the energy stored in the plants. They can use the energy for their own life processes.)* **learning modality: verbal**

All in One Teaching Resources

- Transparency A31

Help Students Read

Identifying Cause and Effect Refer to the Content Refresher, which provides guidelines for Relating Cause and Effect. Have students use a cause and effect graphic organizer to identify the causes and effect in the process of photosynthesis. Have them begin with light hitting the plant's leaf and end with the production of sugar.

Monitor Progress L2

Writing Have students write a paragraph that summarizes the process of photosynthesis. Students can save their paragraph in their portfolios.

Portfolio

Answer

Reading Checkpoint Chlorophyll

Address Misconceptions L2

What do plants need?

Focus Students may know that water is a key ingredient for plant growth, but they may not realize the importance of light and carbon dioxide, since these are less tangible.

Teach Ask: **What is a unique ability of most plants, not shared by animals?** *(They can make their own food through photosynthesis.)* Emphasize that the "food" plants make is sugar, $C_6H_{12}O_6$. The carbon and oxygen atoms in the sugar molecule both come from carbon dioxide in the air. The hydrogen atoms in the sugar come from water. Light energy is what initiates and powers the chemical process.

Apply Ask: **What would happen if a plant did not receive enough carbon dioxide or light?** *(It wouldn't be able to make sugar.)*

learning modality: logical/mathematical

Go Online active art

For: The Photosynthesis Process activity
Visit: PHSchool.com
Web Code: cep-1042

Students investigate the process of photosynthesis.

Use Visuals: Figure 9

The Photosynthesis Process

Focus Remind students that the purpose of photosynthesis is to capture the energy of sunlight and change it into a form that the plant can use for life processes.

Teach Write the equation for photosynthesis on the board. Then direct students' attention to Figure 9. As a volunteer reads the word equation, have students find the appropriate parts in the figure. Emphasize that the parts of the equation to the left of arrow are materials entering the plant before photosynthesis takes place. Those to the right are the products of photosynthesis.

Apply Ask: **Where does the plant obtain carbon dioxide for photosynthesis?** *(From the air)*

Go Online active art

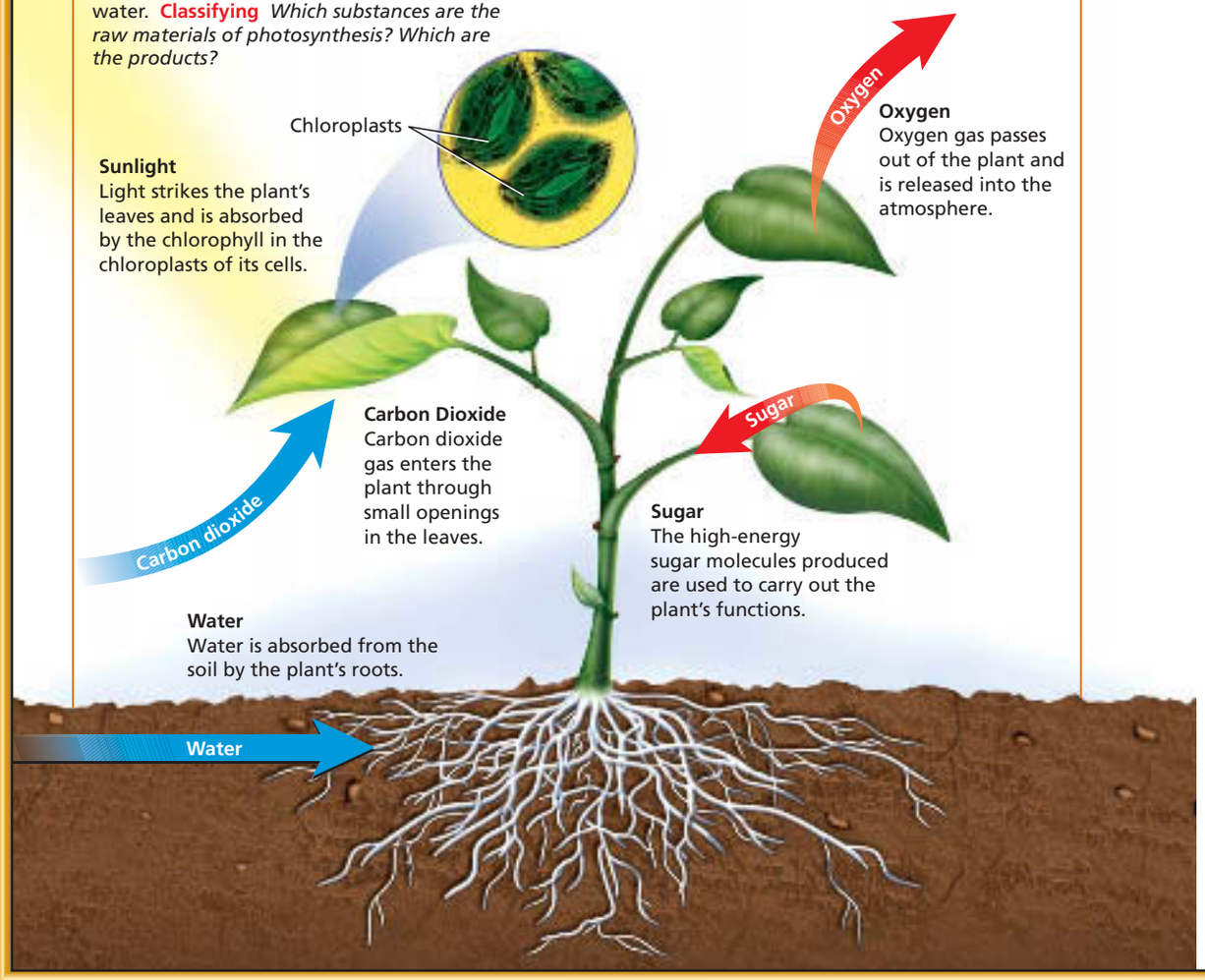
For: The Photosynthesis Process activity
Visit: PHSchool.com
Web Code: cep-1042

The Chemistry of Photosynthesis Light energy is just one of the things that plants need to carry out photosynthesis. Just as you need flour and eggs to make cookies, a plant also needs raw materials to make its own food. Plants use carbon dioxide gas and water as raw materials for photosynthesis.

During this stage of photosynthesis, plants use the energy absorbed by chlorophyll to power a series of complex chemical reactions. In these reactions, carbon dioxide from the air and water from the soil combine to produce sugar, a type of carbohydrate. Another product, oxygen gas, is also produced. The events of photosynthesis are pictured in Figure 9.

FIGURE 9
The Photosynthesis Process

In photosynthesis, the energy in sunlight is used to make sugar and oxygen from carbon dioxide and water. **Classifying** *Which substances are the raw materials of photosynthesis? Which are the products?*



Differentiated Instruction

Gifted and Talented L3

Students with good math skills may be interested in balancing the chemical equation for photosynthesis. Tell students that the chemical equation is balanced when the same number of each kind of atom is accounted for both before and after the reaction. Be sure students understand that they cannot break up molecules as they try to balance the equation. The balanced equation for photosynthesis is

$$6(CO_2) + 6(H_2O) \xrightarrow{\text{light energy}} C_6H_{12}O_6 + 6(O_2).$$

learning modality: logical/mathematical

The Photosynthesis Equation Scientists write equations to describe chemical reactions. A chemical equation shows raw materials and products. **The many chemical reactions of photosynthesis can be summarized by this equation:**

$$\text{carbon dioxide } (CO_2) + \text{water } (H_2O) \xrightarrow{\text{light energy}} \text{sugar } (C_6H_{12}O_6) + \text{oxygen } (O_2)$$

You can read this equation as, "carbon dioxide and water combine in the presence of light to produce sugar and oxygen." Photosynthesis takes place in the parts of a plant that contain chlorophyll.

Like all organisms, plants need a steady supply of energy to grow and develop, respond, and reproduce. The food made by plants during photosynthesis supplies energy for these processes. Any excess food made by plants is stored in their roots, stems, leaves, or fruits. Carrot plants, for example, store excess food in their roots. When you eat a carrot, you are eating the plant's stored food.

The other product of photosynthesis is oxygen. Most of the oxygen produced during photosynthesis passes out of the plant and into the air. It can then be used by other organisms for their body processes.

Reading Checkpoint **What are the products of photosynthesis?**

FIGURE 10
Food Made by Plants
You can enjoy the results of photosynthesis in a salad. When you eat cucumbers, tomatoes, and other plant products, you are eating food made and stored by plants.

Section 2 Assessment

Target Reading Skill **Previewing Visuals** Refer to your questions and answers about photosynthesis to help you answer Question 2.

Reviewing Key Concepts

1. a. **Listing** What are three things that might happen to light when it strikes an object?
   b. **Relating Cause and Effect** What happens when light strikes a green leaf? How does this explain why leaves appear green?
   c. **Predicting** Predict whether a plant would grow better when exposed to green light or to blue light. Explain.
2. a. **Reviewing** What is the overall equation for photosynthesis?
   b. **Summarizing** In a sentence, summarize what happens during each of the two stages of photosynthesis.
   c. **Applying Concepts** Explain how each of these conditions could affect photosynthesis in a plant: (a) cloudy weather, (b) drought, (c) bright sunlight.

Lab zone At-Home Activity

Reflecting on Light With a family member, look around your kitchen for objects that transmit, reflect, and absorb white light. Explain to your family member what happens to white light when it strikes each object. Then, choose one of the objects and explain why you see it as the color you do.

Lab zone At-Home Activity

Reflecting on Light L2 Suggest students look at windows, plastic bags, shiny bowls, mirrors, and colored objects. Students should explain that white light is transmitted through clear objects and reflected by shiny objects. Colored objects absorb all the colors in white light except the color that you see. That color is reflected by the object.

Lab zone Chapter Project

Keep Students on Track Students should be completing their research of the processes used to change a plant or plant materials into their chosen item. Inform students that they should be designing their exhibit using an outline, storyboards, or a flowchart to organize their ideas.

Monitor Progress L2

Answers

Figure 9 Water and carbon dioxide are the raw materials; sugar and oxygen are the products.

Reading Checkpoint Sugar and oxygen

Assess

Reviewing Key Concepts

1. a. It might be transmitted, reflected, or absorbed **b.** Most of the green light is reflected; other colors are absorbed. Because we see the reflected light, the leaf appears green. **c.** Plants use the energy they absorb to power photosynthesis, and since plants' chlorophyll reflects green light, a plant will do better in blue light.

2. a. carbon dioxide + water $\xrightarrow{\text{light energy}}$ sugar + oxygen. **b.** In the first stage of photosynthesis, light energy is absorbed by the plant's chlorophyll to power the complex chemical reactions of second stage, in which water and carbon dioxide combine to form sugar and oxygen. **c.** Cloudy weather will slow down or halt photosynthesis because there is less sunlight; drought deprives a plant of a necessary raw material, and so the plant will not be able to make food; a plant in bright sunlight with adequate carbon dioxide and water will have what it needs for photosynthesis.

Reteach L1

Provide students with an illustration of photosynthesis similar to Figure 9, including arrows but without labels. Ask students to provide labels so that the illustration shows the complete photosynthesis process.

Performance Assessment L2

Drawing Have students use colored pencils to draw what happens when white light strikes different-colored objects. *(Students' drawings should show white light shining on an object of a certain color, with that color of light reflected and all other colors being absorbed.)*

All in One Teaching Resources

- Section Summary: *Photosynthesis and Light*
- Review and Reinforce: *Photosynthesis and Light*
- Enrich: *Photosynthesis and Light*

Eye on Photosynthesis L3

Prepare for Inquiry

Key Concept
Plants require several factors to be present before photosynthesis can occur.

Skills Objectives
After this lab, students will be able to
- design experiments to determine what substances and conditions are necessary for photosynthesis
- perform tests on several variables
- analyze the results of their tests and draw conclusions

Class Time 45 minutes

Advance Planning
Obtain *Elodea* plants. Prepare the sodium bicarbonate solution by using 0.5 g of sodium bicarbonate for each 100 mL of water. Boil water for Part 2 and let it cool.

Alternate Materials
If *Elodea* plants are not available, you may be able to find appropriate small water plants at a tropical fish supply store.

Safety
Caution students to be careful with the glass test tube and container. Remind them to wash their hands thoroughly after the lab. Review the safety guidelines in Appendix A.

All in One Teaching Resources
- Lab Worksheet: *Eye on Photosynthesis*

Guide Inquiry

Invitation
Ask students to describe what might happen to a plant to make it turn brown instead of staying green. *(Sample: Too much sun, not enough water, disease, pests, change of seasons, poor soil)* Then have them describe the things plants need in order to be green and healthy.

Introduce the Procedure
- Have students use water to perfect their techniques of immersing a filled test tube before they use the sodium bicarbonate solution or boiled water.
- As students read through Steps 3 and 4, make certain they refer to the photograph.

Lab zone Design Your Own Lab

Eye on Photosynthesis

Problem
What raw materials and conditions are involved in photosynthesis?

Skills Focus
observing, controlling variables, designing experiments

Materials
- *Elodea* plants
- water (boiled, then cooled)
- wide-mouthed container
- sodium bicarbonate solution
- 2 test tubes
- wax pencil
- lamp (optional)

Procedure

PART 1 Observing Photosynthesis

1. Use a wax pencil to label two test tubes *1* and *2*. Fill test tube 1 with sodium bicarbonate solution. Sodium bicarbonate provides a source of carbon dioxide for photosynthesis.
2. Fill the wide-mouthed container about three-fourths full of sodium bicarbonate solution.
3. Hold your thumb over the mouth of test tube 1. Turn the test tube over, and lower it to the bottom of the container. Do not let in any air. If necessary, repeat this step so that test tube 1 contains no air pockets. **CAUTION:** *Glass test tubes are fragile. Handle the test tubes carefully. Do not touch broken glass.*
4. Fill test tube 2 with sodium bicarbonate solution. Place an *Elodea* plant in the tube with the cut stem at the bottom. Put your thumb over the mouth of the test tube, and lower it into the container without letting in any air. Wash your hands.
5. Place the container with the two test tubes in bright light. After a few minutes, examine both test tubes for bubbles.
6. If bubbles form in test tube 2, observe the *Elodea* stem to see if it is producing the bubbles. The bubbles are oxygen bubbles. The production of oxygen signals that photosynthesis is taking place.
7. Leave the setup in bright light for 30 minutes. Observe what happens to any bubbles that form. Record your observations.

Troubleshooting the Experiment
- Make sure students do not grip the test tubes too tightly. Remind students to tell you immediately if anything breaks.
- Tell students not to expect dramatic results. Have them look for small bubbles of oxygen.
- Remind students to move on to the next procedure while they are waiting for results.

Expected Outcome
Students should observe tiny bubbles forming along the stems or leaves of the plant in Part 1. These bubbles will grow larger with time. If no bubbles are present, review the variables and make a fresh cut in the *Elodea* stem. Make sure all variables, such as sunlight, are at their maximum. Observations will support or reject students' hypotheses on whether a particular variable is important in photosynthesis.

PART 2 Is Carbon Dioxide Needed for Photosynthesis?

8. Your teacher will provide a supply of water that has been boiled and then cooled. Boiling removes gases that are dissolved in the water, including carbon dioxide.
9. Based on what you learned in Part 1, design an experiment to show whether or not carbon dioxide is needed for photosynthesis. Obtain your teacher's approval before carrying out your experiment. Record all your observations.

PART 3 What Other Conditions Are Needed for Photosynthesis?

10. Make a list of other conditions that may affect photosynthesis. For example, think about factors such as light, the size of the plant, and the number of leaves.
11. Choose one factor from your list. Then design an experiment to show how the factor affects photosynthesis. Obtain your teacher's approval before carrying out your experiment. Record all your observations.

Analyze and Conclude

1. **Observing** What process produced the bubbles you observed in Part 1?
2. **Controlling Variables** In Part 1, what was the purpose of test tube 1?
3. **Designing Experiments** For the experiments you carried out in Parts 2 and 3, identify the manipulated variable and the responding variable. Explain whether or not your experiments were controlled experiments.
4. **Drawing Conclusions** Based on your results in Part 2, is carbon dioxide necessary for photosynthesis?
5. **Posing Questions** What question about photosynthesis did you explore in Part 3? What did you learn?
6. **Communicating** In a paragraph, summarize what you learned about photosynthesis from this investigation. Be sure to support each of your conclusions with evidence from your experiments.

More to Explore

A small animal in a closed container will die, even if it has enough water and food. A small animal in a closed container with a plant, water, and food will not die. Use what you have learned from this experiment to explain these facts.

Analyze and Conclude

1. Photosynthesis

2. It was a control, to show whether the bubbles were truly related to the plant.

3. Sample answer: The manipulated variable was the presence or absence of sunlight. The responding variable was the production of oxygen. My experiment was controlled because I kept all the other variables the same for both test tubes.

4. Yes. Students' answers should reveal that no bubbles were formed when the plant was not exposed to a source of carbon dioxide.

5. Answers will depend on students' procedures, but students should realize that the most important factors for photosynthesis are light and the presence of carbon dioxide and water.

6. Students' paragraphs will vary, but each should conclude that carbon dioxide, water, and sunlight are needed for photosynthesis. Students should support their claims by citing their own observations from parts 1, 2, and 3 of the lab.

Extend Inquiry

More to Explore A small animal in a closed container will die once all the oxygen in the air has been used up, even if it has enough food and water. In a closed container with a plant, food, and water, a small animal can survive because the plant produces oxygen from photosynthesis. In this case, the small animal will have the oxygen, food, and water it needs.